



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,003	03/30/2004	Ja-Hum Ku	2421-000037/US	2675
30593	7590	11/03/2005	EXAMINER	
HARNESSE, DICKEY & PIERCE, P.L.C.			LEE, CHEUNG	
P.O. BOX 8910			ART UNIT	
RESTON, VA 20195			PAPER NUMBER	
			2812	
DATE MAILED: 11/03/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/812,003

Applicant(s)

KU ET AL.

Examiner

Cheung Lee

Art Unit

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Specification

1. The incorporation of essential material in the specification by reference to an unpublished U.S. application, foreign application or patent, or to a publication is improper. Applicant is required to amend the disclosure to include the material incorporated by reference, if the material is relied upon to overcome any objection, rejection, or other requirement imposed by the Office. The amendment must be accompanied by a statement executed by the applicant, or a practitioner representing the applicant, stating that the material being inserted is the material previously incorporated by reference and that the amendment contains no new matter. 37 CFR 1.57(f).
2. The disclosure is objected to because of the following informalities: in paragraph 38, line 2, it needs a space between "typically" and "comprising". In paragraph 41, line 9; and in paragraph 42, line 5, the metal alloy layer number is not 30, it needs to be corrected to 71.

Claim Objections

3. Claims 10, 11, 21, 22, 34, 35 are objected to because of the following informalities: it needs a comma or a semicolon between "°C" and "and" instead of a dot.
4. Claim 36 is objected to because of the following informalities: it needs a space between "about" and "0.5".

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In claims 1, 12, and 23, lines 6, 8, and 11, respectively, it is not clear where the silicon surfaces come from, and in lines 3, 4, and 8, respectively, it is not clear where to form a silicide blocking layer.

Claims 2-11, 13-22, and 24-40 depend from claims 1, 12, or 23, so they are rejected for the same reason.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1, 23, 24, 28, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over En et al. (US Pat 6518631; hereinafter "En") in view of Aloni (US Pat 6458702).
7. With respect to claims 1 and 23, referring to figures 3A-3F, En discloses a method of forming a semiconductor device comprising, in order: forming an active region 318 in a semiconductor substrate 340; forming a gate electrode 336 structure in

Art Unit: 2812

the active region; implanting a first dopant into the active region adjacent the gate electrode structure (see col. 5, lines 15-18); forming spacers 368, 378 adjacent the gate electrode structure; implanting a second dopant into the active region adjacent the spacers ([Claim 1] to form source/drain region 324, 326); annealing the semiconductor substrate at a temperature T_a (col. 6, lines 38-67) to activate the first and second dopants; exposing a silicon surface (see fig. 3C); and forming a silicide layer (364, 366, 382, 384) on the silicon surface at a silicidation temperature T_s (col. 6, lines 1-25) wherein $T_s < T_a$, but En does not disclose expressly forming a silicide blocking layer.

Aloni discloses forming a silicide blocking layer which covers one region (see fig. 6, item 410A).

At the time of the invention it would have been obvious to a person of ordinary skill in the art to use a silicide blocking layer to selectively forming silicide region, as taught by Aloni.

The motivation for doing so would have been to obtain better control of silicide formation in the non-silicide region:

8. With respect to claim 24, En in view of Aloni discloses wherein forming the silicide layers includes depositing a metal layer on the exposed silicon surfaces, but En in view of Aloni does not disclose expressly wherein the metal layer being capable of forming a silicide at a silicidation temperature T_s of less than 700°C. However, En discloses typical heat cycle temperatures for silicide formation range from 200°C to 700°C depending on the type of metal used (col. 6, lines 15-20), and En discloses nickel

Art Unit: 2812

can be used as silicide metal layer (col. 6, lines 1-5). Since nickel is the metal used in the claimed invention, it is inherent that the siliciding temperature is less than 700°C.

9. With respect to claim 28, En in view of Aloni does not disclose expressly wherein the silicide layer is formed at a temperature T_s that is between about 400 and about 530°C. However, En discloses heat cycle temperatures for silicide formation ranging from 200 to 700°C (col. 6, lines 15-20). In the case where claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. *In re Wertheim*, 541 F. 2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F. 2d 1575, 16 USPQ 2d 1934 (Fed. Cir. 1990).

10. With respect to claim 29, En in view of Aloni discloses wherein the substrate is annealed at a temperature T_a that is at least about 830°C (col. 6, lines 64-67).

11. Claims 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over En in view of Aloni, as applied above, and further in view of Wolf ("Silicon Processing for the VLSI ERA").

12. With respect to claim 25, En in view of Aloni discloses activating the first and second dopants and forming the silicide blocking layer, but En in view of Aloni does not disclose expressly wherein activating the first and second dopants prior to forming the silicide blocking layer to form activated dopants, wherein the formation of the silicide blocking layer tends to deactivate a portion of the activated dopants.

En discloses the deposition of a metal to form a silicide after the annealing (see col. 6, line 64-col. 7, line 15). At the time of the invention it would have been logical to a

person of ordinary skill in the art to form a silicide blocking layer after dopants activation anneal.

Aloni discloses the silicide blocking layer can be formed using BPSG process (col. 4, lines 37-40), and Wolf discloses BPSG process performs under certain temperatures (pages104-105, section 3.4.2.3). So inherently, the dopants will deactivate while forming the silicide blocking layer.

13. With respect to claims 26 and 27, En in view of Aloni discloses forming the silicide blocking layer by BPSG process, but En in view of Aloni does not disclose expressly wherein [Claim 26] the silicide blocking layer is formed at a temperature T_{bl} that is below about 830°C; and [Claim 27] T_{bl} is between about 535 and about 825°C.

Wolf discloses BPSG flows at the lowest temperatures (800-850°C at atmospheric pressure) and even lower temperature using high-pressure conditions (pages104-105, section 3.4.2.3). The arguments concerning overlapping range stated in claim 28 also apply.

14. Claims 30, 31, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over En in view of Aloni and further in view of Ku et al. (US Pat 6329276; hereinafter "Ku").

15. With respect to claims 30 and 31, En in view of Aloni does not disclose expressly wherein [Claim 30] forming a capping on the metal layer before reacting the metal layer with the exposed silicon; and [Claim 31] the capping layer includes a major portion of titanium nitride.

Ku discloses forming a capping layer by depositing titanium nitride on a metal layer before silicide heat treatment (col. 3, line 56-col. 4, lines 2).

At the time of the invention it would have been obvious to a person of ordinary skill in the art to use a capping layer on the silicide metal layer, as taught by ku.

The motivation for doing so would have been to prevent oxidation and overgrowth of silicide metal into an unintended area (see Ku, col. 3, lines 62-65).

16. With respect to claim 36, En in view of Aloni and further in view of Ku does not disclose expressly wherein the capping layer has a nitrogen:titanium atomic ratio of at least about 0.5. However, any variation in nitrogen:titanium atomic ratio in the present claim is obvious in light of the cited art, because the changes in nitrogen:titanium atomic ratio produce no unexpected function. The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the part. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. *In re Aller, Lacey and Hall*, 105 USPQ 233, 235. *In re Reese* 129 USPQ 402, 406.

17. Claims 32-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over En in view of Aloni and further in view of Cabral, JR. et al. (US Pub 2004/0123922; hereinafter "Cabral").

18. With respect to claims 32 and 33, En in view of Aloni does not disclose wherein [Claim 32] the metal layer is nickel alloyed with one or more minor metals, the minor metals being selected from a group consisting of tantalum, vanadium, zirconium,

Art Unit: 2812

hafnium, tungsten, cobalt, platinum, chromium, palladium, niobium and combinations thereof, wherein the minor metals constitute no more than about 20 atomic percent of the metal layer; and [Claim 33] the minor metal is tantalum and is present in a concentration of between about 0.1 and about 10 atomic percent of the metal layer.

Cabral discloses Ni alloying additives preferably include Ta, W, Re or mixture thereof (page 2, paragraph 35), and the most preferable amount of the alloying additive in the Ni alloy layer is from 0.5 atomic % to 10 atomic % (page 3, paragraph 38). The arguments concerning overlapping range stated in claim 28 also apply.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to use Ni alloy and alloying additives as silicide metal, as taught by Cabral.

The motivation for doing so would have been to retard agglomeration of Ni monosilicide phase (page 2, paragraph 35).

19. With respect to claims 34 and 35, En in view of Aloni discloses wherein [Claim 34] $T_a > 750^{\circ}\text{C}$, but En in view of Aloni does not disclose wherein $T_s < 550^{\circ}\text{C}$, and [Claim 35] T_s is between about 400 and about 530°C , and T_a is between about 830 and about 1150°C . However, En discloses T_a ranges from 1020 to 1050°C (col. 6, lines 64-67), and Cabral discloses the most preferable silicide annealing temperatures range from about 400 to 550°C (page 3, paragraph 44). The arguments concerning overlapping range stated in claim 28 also apply. And when the silicide annealing process is performed at a temperature less than 550°C , the claimed limitation is met.

Conclusion

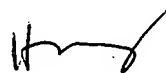
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cheung Lee whose telephone number is 571-272-5977. The examiner can normally be reached on Monday through Friday from 8:30AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Cheung Lee

October 27, 2005



**HA NGUYEN
PRIMARY EXAMINER**